09/706,965

Figure 5 illustrates additional detail of the operations performed by the digital signal processing circuitry of Figure 2.

Figure 6 illustrates additional detail regarding the demodulation module of Figure 5.

Figure 7 illustrates additional detail regarding the decimation module of Figure 5.

Figure 8 represents a more detailed block diagram of the operations of the glucose calculation module of Figure 5.

Figure 9 illustrates the extinction coefficient versus wavelength for several blood constituents.

Figure 10 - 12 depict one embodiment of a probe which can be used to induce an active pulse in accordance with the principals of the present invention.

Figure 13 depicts an example of the an active pulse signal where the modulation is 10% of the entire attenuation through the finger.

Detailed Description of the Invention

Figure 1 depicts one embodiment of a blood glucose monitor system 100 in accordance with the teachings of the present invention. The glucose monitor 100 of Figure 1 has an emitter 110 such as light emitting diodes or a light with a filter wheel as disclosed in U.S. Patent Application No. 09/479,164 (attorney docket number Masimo.014A) entitled Blood Glucose Monitoring System, filed on the same day as this application, and assigned to the assignee of this application, which application is incorporated by reference herein.

The filter wheel with a broadband light is depicted in Figure 1. This arrangement comprises a filter wheel 110A, a motor 110B, and a broadband light source 110C. Advantageously, this unit can be made relatively inexpensively as a replaceable unit. The filter wheel is advantageously made in accordance with U.S. Patent Application No. 09/480,798 entitled Optical Filter for Spectroscopic Measurement and Method of Producing the Optical

of two wavelengths to account for glucose attenuation provides overspecification of the equations. -- Overspecification of the equations discussed below increases resolution. Additional wavelengths to account for other constituents such as fats and proteins or others could also be included. For instance, an additional wavelength at 1100 nm could be added (good attenuation from proteins) and 920 nm (good attenuation from fats). Another constituent often of interest is carboxyhemoglobin. A wavelength for carboxyhemoglobin is advantageously selected at 700-730 nm.

In addition to using multiple precise LEDs, an optical spectroscopic system for generating the optical characteristics over many wavelengths can be used. Such a device is disclosed in U.S. Patent Application No. 08/479,164 entitled Blood Glucose Monitoring System, filed on the same day as this application, and assigned to the assignee of this application, which patent application is incorporated by reference herein.

The sensor 300 further comprises a detector 320 (e.g., a photodetector), which produces an electrical signal corresponding to the attenuated light energy signals. The detector 320 is located so as to receive the light from the emitters 301-305 after it has propagated through at least a portion of the medium under test. In the embodiment depicted in Figure 2, the detector 320 is located opposite the LED's 301 - 305. The detector 320 is coupled to front end analog signal conditioning circuity 330.

The front end analog signal conditioning circuitry 330 has outputs coupled to analog to digital conversion circuit 332. The analog to digital conversion circuitry 332 has outputs coupled to a digital signal processing system 334. The digital signal processing system 334 provides the desired parameter as an output for a display 336. The display 336 provides a reading of the blood glucose concentration.

The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter